In the Specification

Please replace paragraphs [0001] and [0002] with the following:

Related Application

This is a continuation of International Application No. PCT/FR02/01806, with an international filing date of May 29, 2002 (WO 02/097172, published December 5, 2002), which is based on French Patent Application No. 01/06997, filed May 29, 2002.

Field of the Invention

~~The present~~ This invention pertains to the field of molecular beam epitaxy equipment.

Background

Molecular beam epitaxy consists of propelling atoms or molecules to the surface of a substrate in a very strong vacuum ~~so as~~ to avoid any interaction on the course of travel and minimize the contamination that stems from the residual gases of the vacuum. The molecules are produced by heating and ~~by~~ evaporation under vacuum (circa 10^{-10} Torr) in a cell communicating with the epitaxy chamber. The materials used in epitaxy can be of a different nature[[s]] and ~~are presented~~ exist in solid, liquid or gaseous form. They are the constitutive elements of the semiconductor alloys called "compounds" (semiconductor compounds), i.e., formed by a minimum of two simple chemical elements, ~~. For~~ for example, ~~by~~ gallium and nitrogen for GaN or gallium nitride, ~~; of~~ gallium, nitrogen and arsenic for GaAsN. There can be present materials for doping semiconductor compounds, e.g., silicon and beryllium for n or p doping of GaAs. There is described in the state of the art in US 4,424,104 epitaxy equipment comprising an evaporation source closed by a grill.

Summary of the Invention

This invention relates to epitaxy equipment including an epitaxy chamber under vacuum containing a substrate support and at least one cell under vacuum for evaporation of epitaxy material closed by a diaphragm having at least one opening and communicating with the epitaxy chamber by a connecting flange, and a mobile plate positioned opposite the diaphragm such that the distance of the plate from an exterior surface of the diaphragm is variable and has a section corresponding to a section of the diaphragm and a molecular beam is formed at the level of a zone surrounding the plate.

Brief Description of the Drawings

Better comprehension of the invention will be obtained from the description below of a nonlimitative example of implementation making reference to the attached drawings in which:

Fig. 1 represents a longitudinal sectional view of the evaporation cell in the open position;

Fig. 2 represents a longitudinal sectional view of the plasma source in the closed position;

Fig. 3 represents a front view of said plasma source;

Fig. 4 represents a schematic view of the control device;

Figs. 5 and 6 represent the concentration curves of nitrogen in the deposit in relation to the position of the plate;

Fig. 7 is the curve representing the effect of the position of the plate on the deposits implemented on the substrate.

Detailed Description

Please delete paragraph [0012].

Please replace paragraph [0013] with the following:

The ~~object of the present~~ invention ~~is to propose~~ provides equipment making it possible to adjust the characteristics of the beam during its use. For this purpose, the invention pertains in its broadest sense to epitaxy equipment comprising an epitaxy chamber under vacuum containing a substrate support and at least one cell under vacuum for the evaporation of the epitaxy material closed by a diaphragm ~~presenting~~ having openings and communicating with the epitaxy chamber by a connecting flange, characterized in that it ~~moreover~~ comprises a mobile plate the section of which corresponds to the section of the diaphragm and which is positioned opposite ~~said~~ perforated diaphragm.

Please replace paragraphs [0016] through [0019] with the following:

~~Said~~ The plate preferably ~~presents~~ has a section corresponding to the section of ~~said~~ the diaphragm. In a first variant, the plate is mobile in a direction perpendicular to ~~said~~ the diaphragm. The course of ~~said~~ the plate is advantageously 10 millimeters.

According to a second variant, the plate is angularly mobile ~~angularly so as~~ to form a dihedron with the plane of ~~said~~ the diaphragm.

Please replace paragraphs [0022] and [0023] with the following:

According to a first implementation solution, the diaphragm ~~presents~~ has perforations.

According to a second implementation solution, the diaphragm ~~presents~~ has an annular opening.

Please delete paragraph [0024].

Please replace paragraphs [0025] through [0028] with the following:

~~Figures~~ Turning to the drawings, Figs. 1 and 2 represent schematic views of the cavity in ~~the~~ open and closed positions, respectively.

The cavity is delimited by a tubular envelope (1) closed downstream by a perforated diaphragm (2). The structure of this cavity is ~~traditional~~ known and ~~is~~ not described in further detail.

It ~~presents~~ has a disc-shaped plate (3) positioned parallel to the plane of the diaphragm. It is made of metal and ~~presents~~ has a section of 20 mm, corresponding essentially to the section of the source (1).

This plate can be move between a closed position in which it is pressed against the diaphragm and an opened position in which it is spaced apart from the diaphragm by a maximum distance on the order of 10 mm. It is actuated by a mechanism shown in ~~figure~~ Fig. 4, comprising a control rod (4) traversing the wall of the epitaxy chamber (5).

Please replace paragraph [0031] with the following:

The curve in ~~figure~~ Fig. 5 shows the concentration of nitrogen measured by the conventional technique in the field of secondary ion spectrometry (SIMS) in a layer of material $GaAs_xN_{1-x}$ implemented by epitaxy in which x is the concentration of arsenic and 1-x is the concentration of nitrogen.

Please replace paragraph [0034] with the following:

~~Figure~~ Fig. 6 is a similar curve created using the same SIMS technique on a similar layer of $GaAs_xN_{1-x}$~~, but~~ . However, in this case, the concentrations in atoms per cm^3 were converted into % of the single element in the complete alloy. This curve shows that for this particular layer it was possible to vary the concentration of nitrogen in the layer between an essentially negligible value and

a value equal to 1.2%. These values are on the orders of magnitudes of values commonly demanded by users.

Please replace paragraph [0036] with the following:

The following experiment was carried out to demonstrate this effect:

The curves of ~~figure~~ Fig. 7 show the composition in nitrogen in % (scale at left) and the thickness of the layer in angstrom (scale at right). The abscissa is the distance in which the measurement is made in relation to the center of the substrate (wafer) in mm.

The measurement is performed by X-ray diffraction, a technique which can measure the thickness of a thin layer and the concentration of the various elements that compose it at various points on the surface of the substrate.

It can be seen that the course of the variation of thickness is essentially the inverse of that of the thickness. It is seen that the concentration of nitrogen is low where the thickness is high (center of the zero position layer) and high where the thickness is lowest.

The incident flow of the reactive nitrogen species is the product of the concentration times the thickness, this product being made and represented by the top curve (squared). The curve represents the value V of the flow of the reactive nitrogen species reaching the surface of the substrate.

The calculation from the values V raised on the curve shows a uniformity lower than 1.7%.

Uniformity is defined here as (Vmax-Vmin) divided by the mean value of V equal to (Vmax + Vmin) divided by two.